



The Future of Wires and Cables in the Home

Introduction:

In July 2017, Lennar Homes, the nation's second largest production home builder, announced they were moving away from wired homes in lieu of a robust certified wireless architecture¹. Lennar's approach to providing a wireless infrastructure has its merits; the mindset that wireless is the sole answer for home technology, while very forward thinking, is ultimately incomplete and detrimental to consumers. The purpose of this white paper is to explain why a wired infrastructure, along with a robust wireless network, installed by a trained and certified workforce, is the best approach to delivering high-quality, reliable and secure experiences.

The Benefits and Drawbacks of Wireless

Benefits of Wireless

There are many benefits to wireless devices and communication. The greatest benefit is obvious: not being tethered to a cord enables mobility and freedom. Being able to take technology with you wherever you like is one of the great conveniences of the modern age. Wireless devices are made at-scale and are ubiquitous and incredibly affordable. In fact, many internet service providers underwrite the cost of equipment and installation and make it up through a nominal monthly fee, which is often very attractive to consumers and providers alike. The other major tangible benefit of wireless is that home installation is non-invasive. By using wireless access points, there is usually no need for new cables to be run, making the cutting of holes in walls and ceilings unnecessary. Combined with relatively easy configuration, wireless networks are often the first choice for many people.

Drawbacks of Wireless

In order to communicate, all wireless technologies must send/receive data over specific frequencies (sometimes referred to as channels). Unfortunately, there are only a few frequencies available in which consumer electronic equipment can legally operate. This is due to the finite nature of the available electromagnetic spectrum (frequencies), which are regulated by each country's government as well as the International Telecommunications Union. The overwhelming majority of wireless electronics, and the network they operate on, are crammed into just two narrow frequency bands: 2.4 GHz and 5 GHz. These frequencies are crammed with products such as microwaves, Bluetooth headphones, printers, and digital cameras, which create a mass of interference.

¹ <https://www.lennar.com/wifi-certified>

In simple terms, interference makes it more difficult for wireless devices to communicate effectively. A good analogy is holding a conversation. If you are in a quiet room, it is easy to hold a conversation, while conversing at a rock concert is much more difficult.

Another drawback for wireless networks is uneven coverage within the home. Wireless technologies utilize radio frequencies which can be reflected and/or weakened (called attenuation) as they collide with or traverse through objects such as HVAC duct work, drywall, brick, and doors. Due to how radio signals propagate, null points (often called dead spots) occur, which creates a frustrating experience for homeowners. Null points are difficult to predict, particularly for novices and/or homeowners who do not have the tools to predict signal strength at all points of the home.

The Benefits and Drawbacks of Wire and Cables

Just as wireless has both strengths and weaknesses, wires and cables do too. But before explaining them, it is important to establish the differences between wires and cables.

What is a Wire? A wire is simply an elongated piece of metal (often called a conductor) used to send power, a signal, or both from one device to another. Wires are made of a particular metal (most often copper) and thickness, which determines its efficiency to transport a signal, power, or both. Wires can be bare or coated with a protective outer jacket. Figure 1 shows an example of speaker wire. This has four separate conductors, which is used for one pair of speakers. Prewiring your home or building with speaker wire allows consumers significantly greater flexibility and choice in the speakers and where they can be placed.



Figure 1: Kordz One Speaker Cable



Figure 2: Kordz Pro HDMI Cable

What is a Cable? A cable is a purpose-designed collection of wires used to transmit/receive signals and power, along with the ability to shield out unwanted signals. Each wire within a cable is strategically placed; in some circumstances, a wire is separated from other wires in the cables to allow for maximum efficiency. Each wire in a cable has a jacket to isolate it from other wires, as well as protecting it during installation. Cables also use a specific connector, built to an industry standard, allowing it to plug into specific equipment. In an HDMI cable (seen in Figure 2), there are nineteen individual wires within the cable. Each wire has a specific task and taking care of it during installation will help assure high performance.

Cables Shield Against Interference

Cables are engineered and manufactured with interference in mind. There are main two types of signal interference: ingress, where outside signals penetrate the cable; and egress, where a signal leaks out of a cable and can hop on a nearby cable or interfere with a wireless signal.

To combat ingress and egress, cable manufacturers utilize shielding, which is typically constructed of either foil (aluminum), woven braid, or a combination of the two. Sometimes cables even have four layers of shielding where braid and foil overlap two times (often referred to as quad shield). It is important to note that the number of strands and the overall percentage of braiding affects how well a cable's shielding performs. Properly shielded cables provide a great deal of immunity to interference and keep the original signal intact, enabling a high-quality experience.

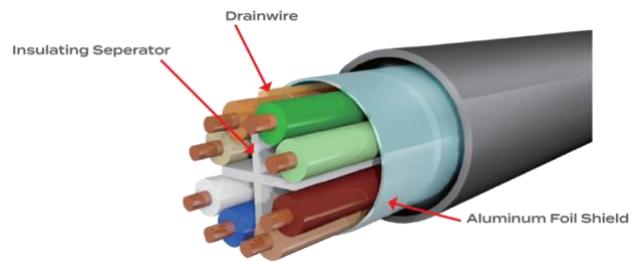


Figure 3: Kordz Cat 6a Shielded FUTP Cable

Wires and Cable Can Power Devices

Beyond sending data back and forth, cables and wires have the ability to power your devices. Every electronic device needs power to operate, whether it is speakers, television, cell phones, or a security system. An example: Lennar stated that they are moving from wired speakers to wireless Sonos speakers. While Sonos is a fantastic brand, its speakers still require power, so instead of running speaker wire to an amplifier, they are plugged into an electrical outlet.

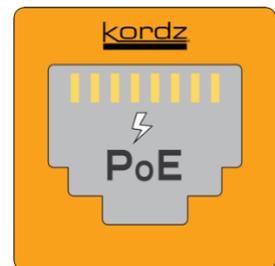


Figure 4: Power over Ethernet

Hard-wired cables are often multi-purpose, meaning it can both power the electronics as well as transmit and receive data. A common example is Power over Ethernet, often referred to as PoE. PoE supplies up to 25 watts at 48 volts dc (or more, depending on the version) of power while also being directly connected to the network. Using PoE switches with Cat5e and Cat6 cable have been effectively used for years in commercial and industrial applications and are moving rapidly into the home. PoE is considered an intrinsically safe system, as it operates within low-voltage levels. PoE is also very convenient. A few examples of PoE uses are surveillance cameras, telepresence, and lighting control. Kordz expects the PoE category to grow exponentially in the residential and commercial markets moving forward. It's not hard to imagine a future where homes are wired exclusively (except for high-powered appliances) with Category Cat5e, Cat6 or Cat8 cable as its communications and power backbone.

Wires/Cables Provide Improve Performance Quality



Figure 5: Kordz EVS HDMI Cable

As stated above, wireless technologies communicate within heavily congested frequencies. While convenient for setup, consumers sacrifice quality. The reason for this sacrifice is in large part due to compression. Wireless technologies, even today, compress content significantly in order to fit the data into their pipeline. This holds true for both audio and video.

A good way to demonstrate this is to look at Ultra HD/4K video. Many people have bought high-quality televisions and projectors. However, instead of using a wired connection, they rely on wireless for their television watching. While wireless works well, it doesn't work great. There are two reasons for this, the first is increased compression and the second is based on inherent wireless/internet limitations. Video on Netflix is compressed to approximately 25 Mbps (25 million bits per second)² which is more than other formats in order to make it easier to transfer over the internet and through the home network. The quality of the content and television or projector, will determine how

noticeable the difference is between these two formats.

The second issue that streaming video is based on the quality of the internet connection, be it from the internet service provider (ISP), the number of devices connected using data on the network and other devices from neighbors, not connected to the network, but using the same frequencies. These can result in buffering, where the image stalls, pixelate or change in resolution. There is no buffering with HDMI cables, particularly when using content that doesn't rely on an internet connection. This direct connection between the source device and the television with an HDMI cable, which is isolated from interference, results in an uninterrupted experience. While this may seem like merely a nuisance, choppy or discontinuous video during a movie takes the viewer out of the story they've been watching, and the suspension of disbelief is gone.

Wires/Cables Provide Increased Flexibility and Choice

It may sound counter intuitive, but having cables/wires (as opposed to wireless) actually increases flexibility and choice. Below are a few examples of how wires/cables add choice.

² <https://help.netflix.com/en/node/306>



Audio: With wireless speakers, consumers are limited to the mass market/commoditized speakers, which at best vary in quality. By simply adding speaker wire (and yes, quality matters) before the finished walls go up, the consumer has much greater choice in speaker quality, placement, volume, and visibility. By having wires in the wall, it is possible to make the speakers as obvious or invisible as desired.

Video: Over the last few years, particularly in the United States, consumers moved away from traditional cable and satellite providers in favor of streaming video services. There are limitations to streaming services, however, particularly access to local channels and live sporting events. This has reinvigorated the use of off-air antennas, which provide free, high-quality access to these channels. This will only increase in the next few years as a new broadcast format (called ATSC 3.0) enables many features, including Ultra HD/4K, high dynamic range (HDR), interactive services, and multi-channel immersive audio³.



Better Streaming: Just like choice for audio, wiring a home with the proper network infrastructure in the home allows for increased flexibility and performance.

Drawbacks of Wires and Cables

There are certainly some drawbacks to installing cables and wires. They are often cumbersome, bulky, and must be connected to the device in order to work. Cable connections are impractical for mobile phone and tablet use. Cables are also typically more expensive to run in existing homes than to establish a wireless infrastructure. Cables also have the possibility of becoming outdated in several years, as it is difficult to determine the future. This is why it is also a good idea to use strategically placed flexible conduit for future upgrade paths. Make sure to check local codes and regulations for conduit installation.

³ www.atsc.org

Next Steps

The purpose of this white paper is to help clarify when and where wired vs. wireless infrastructure is needed.

Wireless Next Steps

For a wireless infrastructure in the home, the size of the house matters. For anything over 1,500 ft² (140 m²), multiple wireless access points should be planned for and installed. There are multiple options and price points; however, using a system that is either a wireless mesh network system, or a more complex system utilizing a wireless controller and firewall, will help ensure a more seamless experience. In layman's terms, a Wi-Fi mesh network system (or above) makes the internet connection appear as one, despite using multiple access points. While it may not seem that important, this will significantly improve the wireless experience on mobile devices throughout the home. If you are unsure of placement, a home technology professional can perform a site survey and use specialized test equipment to identify where to place the wireless access points to maximize the coverage throughout the home.

At least one of the wireless access points must be hard wired, and Kordz recommends a minimum of Cat6 or Cat6a cable. It is also a good idea to run Cat6 or Cat6a to each of the wireless access points. While most systems these days can communicate via wireless, they do so at a cost of speed, as wireless communication is half duplex (send then receive) whereas hard wired is full duplex (send and receive concurrently). If possible, it is also a good idea to pull a fiber optic cable along with the Cat6/Cat6a cable for future upgrades or a flexible conduit as mentioned earlier in this paper.

Wireless audio is another area to consider. While the speakers play music without a connection to a receiver or amplifier, they must still be connected to house power. For more permanent installations, it is worthwhile to think about their placement, particularly with voice assistants built in to ensure the microphones are able to pick up commands. In general, wireless speakers (with or without voice assistants) will be permanently visible, have limited coverage, and vary in sound quality. If a wireless speaker is desired, it is best to have an electrician install an electrical outlet near the speaker location for convenience and ability to hide the power cord.

Wires and Cables Next Steps

Planning for wires in the home is prudent, particularly for new construction and remodels, as it is always cheaper and less intrusive to run wires before drywall/gypsum or plaster go up. An excellent resource for all is the [CEDIA Smart Home Recommended Wiring Guidelines](http://www.cedia.org/files/file/smart-home-recommended-wiring-guidelines-eng-press.pdf)⁴. CEDIA is the global trade association for residential technology design and installation. This 28-page white paper, free to all, defines cabling in three categories: Grade 1, Grade 2 and Bespoke. Kordz recommends this guideline as a resource for home technology professionals, as well as those planning on building or remodeling a home. However, a few generalizations to take away:

⁴ <http://www.cedia.org/files/file/smart-home-recommended-wiring-guidelines-eng-press.pdf>

- TV/Movie Watching
 - HDMI speeds are significantly greater than any residential Wi-Fi system. For areas where picture quality matters, chose HDMI. The quality of HDMI cables matter; for more information, read Kordz's *Choosing the Right Cable* white paper. For hard-to-reach places, it is a good idea to run a flexible conduit first and pull the HDMI cable through it. This ensures any changes to the technology are easily upgraded.
 - For home cinemas or media rooms, it is a good idea to prewire for immersive audio such as [Dolby Atmos](#), [DTS:X](#) and [Auro 3D](#). The size of the room will dictate how many speakers to use and their positioning. If in doubt, consult a home technology professional.
- Listening to Music/Distributed Audio
 - There are many advantages to using hard wired distributed audio, including the ability to hide (partial or fully invisible) speakers, create uniform coverage, and significantly broaden the choice of speakers. Running speaker wire, typically 16/2 (16-AWG with two conductors) to a few locations that may in the future have speakers ,will be an inexpensive way to plan for future use. This holds true for both indoor and outdoor audio.
- Networking
 - Any devices requiring intensive data transfers should be connected via Cat 6 or Cat6a. As discussed in the wireless section, wired connections can send and receive data simultaneously (full duplex), so the transfer speeds are faster and more reliable. Items to consider hardwiring via network are media servers, Network Attached Storage (NAS), and streaming devices/displays in critical areas. Any highly sensitive data or devices are also more secure via hardwire than wireless, particularly if they are either on a segmented virtual local area network (VLAN) with a firewall or on a completely separate network.

It is also a good idea to add flexible conduit at strategically placed locations to allow future upgrades; it is difficult to know where technology will be in 10 to 20 years, but you can be sure that it will include wires and cables.

Conclusion

There is no denying that technology is fully ingrained in our lives. From the moment we wake up to very last minute before falling asleep, technology surrounds us. It is therefore paramount to design a system for long-term use, as well as considering performance and budget. The best way to accomplish this, in Kordz's opinion, lies in a well-thought-out system that balances between wired/cable infrastructure and a robust, professionally installed wireless network. Visit www.kordz.com to find your local Kordz dealer who can design and install your future-ready home.